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THE EVALUATION ASPECT OF DIGITAL BUSINESS MODEL INNOVATION: A LITERATURE REVIEW ON TOOLS AND METHODOLOGIES

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Research paper

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Abstract

Despite the increasing importance of business model innovation (BMI), a lack of understanding on the evaluation aspect still exists within research. Thereby, the development of tools and methodologies for BMI lacks sufficient consideration in both theory and practice. This paper contributes by systematically reviewing present literature with an explicit focus on the applicability in digital BMI projects. The authors elaborate a categorization of tools and methodologies concerning two major logics of evaluation: Analytical/effectual and quantitative/qualitative. This sheds light upon the dominant mode of evaluation within different stages of digital BMI processes.

Keywords: Business model innovation, evaluation, decision making, tooling

1 Introduction

External factors, like fast technological change, rising competition and dynamically changing market structures increasingly force established firms to continuously innovate their business models (BM) (Reuver *et al.*, 2009; Bucherer and Uckelmann, 2011; Doz and Kosonen, 2010). A major technological change companies are facing is digitalization (Wirtz *et al.*, 2010). This trend enables the success of many non-traditional market players, whose business model is purely digital and based on information rather than physical products. One recent example is AirBnB in the rental sector. This company is proposing value to their customers at almost no cost by acting as an intermediary without owning any real estate. Their focus on information-based business models and the independency from self-owned physical assets allows AirBnB to grow rapidly on a global scale and greatly facilitates the ability to capture value (Cannon and Summers, 2014).

As this example demonstrates, this technological change offers many opportunities, e. g. digitalized products and services. Additionally, it also leads to high competitive pressure and poses many challenges, especially to manufacturing firms (Koen *et al.*, 2011; Chesbrough, 2010; Cavalcante, 2014). It means heavy uncertainty and causes many risks for most companies (Magruk, 2015). In the past, many established manufacturing firms relied rather on technology or product innovation instead of business model innovation to achieve transformative growth (Johnson *et al.*, 2008). For these innovation types, evaluation criteria and well established idea-to-launch processes exist, e. g. the "Stage-Gate-Process" (Cooper, 1990; Hart *et al.*, 2003). These criteria and processes help decision-makers lower uncertainty and make well-informed decisions (Bredmar, 2015; Broadbent *et al.*, 2008). Yet, in the field of business model innovation, such tools and processes are still rare.

Nevertheless, the demand for fast decisions of high quality is even higher in a nowadays' complex and dynamic world, due to the complexity and uncertainty of new (digital) business models (Burgeois and Eisenhardt, 1988; Vecchiato, 2012). In particular, established, producing firms ask for information, decision support and processes to lower their uncertainty and to make well-founded decisions (Eisenhardt,

1989; Eiselt and Marianov, 2014). Evaluations about the possible outcomes of the proposed business model help to generate the needed information to reduce uncertainty and manage business model risks (Thompson and MacMillan, 2010). This helps reduce the probability of failure of business model innovation and creates additional new opportunities (Taran *et al.*, 2015).

To the best of our knowledge, no comprehensive and structured literature review of evaluation methods and criteria on digital business model innovation exists in literature so far. Hence, aim of this paper is to review the status quo through a sophisticated keyword search in order to structure the field and to propose a typology. This forms the basis for an integrative framework, guiding future research to discover the role of methods and tools in different stages of a BMI project. Moreover, it aims at establishing a basis to elaborate new tools and methodologies for both practitioners and scholars.

This paper is structured as follows: In section two, the underlying theoretical concepts are explained and a short outline of the existing literature dealing with the business model evaluation aspect is presented. Section three details the chosen methodology for literature review and provides an overview of the search process. To get a comprehensive and structured picture of existing literature in this field, this paper presents a literature review based on the methodology of Webster and Watson (2002) and Levy and Ellis (2006). The results are presented in section four, starting with a graphical overview about all identified evaluation methodologies and tools which will also serve as a basic framework for the chosen structure. Section five discusses results of this literature review and presents an integrative framework for digital business model innovation. In section six, avenues for future research are discussed. The paper closes with a conclusion in section seven.

2 Theoretical Background and Existing Literature Reviews

2.1 Theoretical Background

2.1.1 Business Model and Business Model Innovation

Traditional forms of digital business models are becoming more and more challenged by the turbulent changes in political, economic, social and legal circumstances. In the wake of a shift from purely physical products and services enabled by technological advancements and digital transformation, emerging players seek to innovate existing business models (Fichman *et al.*, 2014, Yoo *et al.*, 2010). The research field around *business model* topic has garnered humongous attention among several disciplines, such as Information Systems, Strategic Management, and Technology and Innovation Management (Zott *et al.*, 2011). Therefore business models are often defined in various ways (Wirtz *et al.*, 2016). According to Teece (2010, p. 17) “A business model articulates the logic and provides data and other evidence that demonstrates how a business creates and delivers value to customers.” The goal is “both value creation and value capture” (Zott *et al.*, 2011, p. 1020). Casadesus-Masanell and Ricart (2010, p. 198) describe that “business models are made of concrete choices and the consequences of these choices”. Hence, these authors emphasize the importance of decisions and decision-making in business model development.

Next to the term “business model”, also a variety of different definitions of the concept of *business model innovation* exist. Business model innovation describes the further development of an existing business model or the creation of a totally new model (Bucherer and Uckelmann, 2011; Amit and Zott, 2010). It targets at creating value for the customer and, at the same time, capturing value for the company (Bereznoi, 2015; Yunus *et al.*, 2010). One important driver of business model innovation is the digital transformation. It is continuously challenging firms to innovate their business model. If businesses restrain themselves from engaging in digital innovation, other firms will capture the latent value by themselves (Chesbrough, 2010).

2.1.2 Decision-Making in Business Model Innovation

One key aspect in the context of doing business is decision-making (Bredmar, 2015; Broadbent *et al*., 2008). This also affects the process of business model innovation. Decisions can be made at different levels and based on different decision logics. Tesch *et al.* (2016, 2017) revealed the occurrence of two major decision points across the process of all investigated IoT business model innovation cases in their study. The decision, whether or not to finance customer-centric business model prototyping and testing, is based on criteria mainly elaborated by purely analytical work. The second decision, whether to scale and roll out the business model in at least sub-markets, is done on base of the evaluation of the prototype business model. One decision logic according to these findings is the effectual (prototype testing) vs. causal (analytical work) decision approach (Sarasvathy, 2001).

The effectual decision concept is especially used by entrepreneurs (Dew *et al.*, 2009), where decision-making aims at creating the future, rather than trying to achieve a specific scenario. The effectual rationale considers the "affordable loss", seeing the future as unpredictable, and focuses on a set of given means to create an effect (Sarasvathy, 2001). Thereby, experimentation and flexibility are characteristic for this logic (Chandler *et al.*, 2011). In general, effectuation is described as discovery-driven approach with the underlying assumption "to the extent we can control the future, we do not need to predict it" (Sarasvathy, 2001, p. 251). Effectuation is expected to foster innovativeness in situations of high uncertainty (Sarasvathy, 2001; Chandler *et al.*, 2011). Also corporations may consider effectuation for BMI (Thompson and MacMillan, 2010). In contrast, causal evaluation models determine the future as predictable. In this decision concept, approaches from the field of strategic planning are used (Chandler *et al.*, 2011). Thereby, the causal logic tries to choose means to create a previously identified effect (Sarasvathy, 2001; Chandler *et al.*, 2011), claiming that "to the extent we can predict the future, we can control it" (Sarasvathy, 2001, p. 251).

Two other important aspects closely related to decision-making are uncertainty and risk (Broadbent *et al.*, 2008). When deciding between choices of possible business model designs on a strategic stage, or also when considering tactics (Casadesus-Masanell and Ricart, 2010), decision-makers have to find an optimal relation between acceptable risk and estimated return. By improving the information base of decision-makers with evaluation criteria and tools, uncertainty can be lowered and risks can be effectively managed (Thompson and MacMillan, 2010). This helps to reduce the probability of failure of business model innovation and creates additional opportunities (Taran *et al.*, 2015).

2.2 Existing Literature on Business Model Evaluation

Overall, there exists a multitude of elaborated research papers in the field of BMI (Schneider and Spieth, 2013; Wirtz *et al.*, 2016) and also in tooling (Heikkilä *et al.*, 2016; Bouwman *et al.*, 2012). Yet, most articles in business model literature are mainly dealing with the general business model understanding and point out the importance and opportunities of business model innovation (Shi and Manning, 2009; Chesbrough, 2007; Bettis *et al.*, 2015; Gambardella and McGahan, 2010; Sosna *et al.*, 2010; Teece, 2010; Johnson, 2010; Johnson *et al.*, 2008). Nevertheless, only a few are taking an explicit view on the aspect of evaluation in BMI. One example is the work of Brea-Solís *et al.* (2015) that analyses the relation between the choices within business model innovation and its consequences. In their article, they focus on the evaluation of business models based on its strengths and weaknesses by investigating the change of Walmart's business model over time. In order to do so, they first have a look at company's main choices within its business model development. Thereafter, they quantitatively analyse the consequences of these choices on the firm's performance. Their results propose that the fact whether a business model is effective or not does not only depend on how it is designed, but also how it is implemented. Moreover, they found out that the choices had a significant effect on performance (Brea-Solís *et al.*, 2015).

A very early research study of Pateli and Giaglis (2004) identifies the evaluation aspect as a subdomain of business model research. However, at this point in time, the aspect was identified as immature, and

studies on the use and effectiveness of tools and methodologies were largely missing. This missing validity of evaluation methods can also be confirmed by later scientific research on business models (Demil and Lecocq, 2010). Besides, two literature reviews are of particular relevance, as these have an IS perspective on business models and take the evaluation aspect into account: Veit *et al.* (2014) and Burkhart *et al.* (2011).

Veit *et al.* (2014) elaborate a research agenda for business model research in the field of IS and categorize their propositions in definitions, components, representations and taxonomies. Furthermore, three domains of IS research are portrayed: "Business models in IT industries", "digital business models" and "IT Support for developing and managing business models" (Veit *et al.*, 2014, p. 47-49). A lack of evaluation methods in business model frameworks was identified, which should be addressed by future research. Furthermore, the authors emphasize that towards investigations on the evaluation aspect, the innovation process of business models and corresponding toolboxes should be in focus.

Burkhart *et al.* (2011) consider the concept of business models and aim at identifying relevant research gaps. The authors review frequently cited literature and identified 30 relevant papers, particularly contributing to the theoretical foundations of the concept. The authors describe the existing heterogeneity of business model definitions and the delimitation of business model and strategy. Furthermore, a categorization of literature is given (Burkhart *et al.*, 2011, pp. 8-13): (a) A classification of the underlying literature, (b) the comprehension of business models, (c) the usage of business models, (d) the focus of business models and (e) the representation and evaluation of business models. In terms of the aspect of evaluation, the authors found that knowledge on evaluation methodologies is still in an infancy state. However, as the keyword search was limited to the search string "Business model*", the findings appear to be too general for the explicit purpose of analysing tools and methodologies for business model innovation.

In sum, existing research studies do not provide a structured and detailed review on the applicability of existing evaluation tools and methodologies in digital business model innovation.

3 Methodology

The approach for the paper at hand stands in line with the methodology of Webster and Watson (2002), as well as Levy and Ellis (2006). An overview of this process is shown in Figure 1.

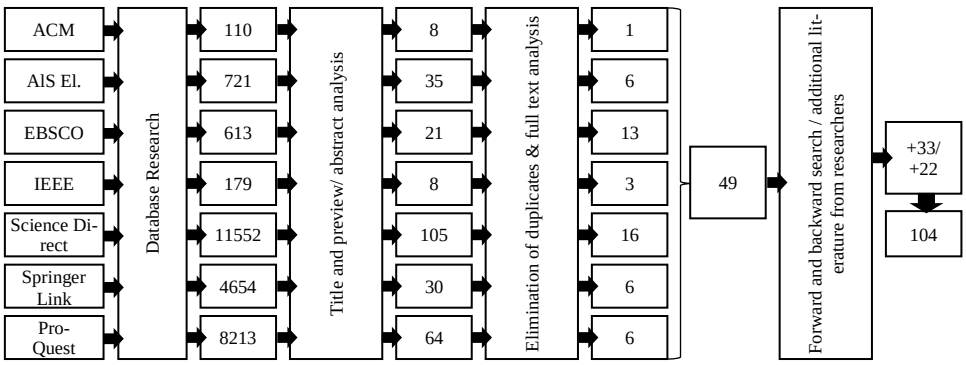

Figure 1. Overview of the search process (own representation)

The search was performed within the scientific databases of the ACM Digital Library, AIS Electronic Library, EBSCOhost, IEEE Xplore Digital Library, ScienceDirect, SpringerLink and ProQuest. The search strings were chosen as follows: "Business Model*" AND "Evaluation"; …"Validation"; …"Stress-Test*"; …"Assessment"; …"Tool*"; …"Method*". The selection of search stings was based on first insights on the topic of the evaluation aspect in digital BMI, which are portrayed in the above sections. To keep the focus on a high quality level, literature rated A+, A to B according to the VHB-

JOURQUAL3 rating (VHB, 2015) was initially considered as relevant. To limit the papers to be considered within a manageable size, just the first 200 results were examined. In order to capture the most relevant papers, the resulting lists returning from the database search were sorted by the descending number of citations.

In the next phase, numerous duplicates were identified and deleted, as several databases revealed identical papers. Title and abstract of the resulting papers were analysed to identify the papers (271) to be analysed in full-text in the following. This resulted in 49 relevant articles.

Within the subsequent forward and backward search based on the 49 articles, the restriction on high-quality research papers based on the VHB-JOURQUAL3 rating was omitted due to the infancy of research on the evaluation aspect in digital BMI. Thereby, research papers from outlets not considered by the VHB-JOURQUAL3 were critically examined for having a rigor methodological approach to investigate the use and effectiveness of the proposed tool. The forward and backward search provided an additional number of 33 articles. Moreover, the team of researchers considered an additional stock of literature from research endeavours in their field, of which 22 scientific and practitioner sources were identified as relevant. The search progress resulted in a total number of 104 articles. However, the key messages (summarized in figure 2), were covered by a total of 57 sources. Only articles in German and English were reviewed.

4 Results: The Evaluation Aspect in Business Model Innovation

Webster and Watson (2002) suggest a "concept-centric approach", so literature is structured and categorized according to certain pre-defined concepts. Since one main target of evaluation methods is the support of decision-makers within the business model development process, a categorization based on the decision logics defined in 2.1.2 seems appropriate. These criteria are: *qualitative vs. quantitative* and *causal* vs. *effectual* evaluation, corresponding to the proposition of Sarasvathy (2001). Figure 2 gives an overview of the various tools and methodologies identified by literature review. The following subsections describe their effect and use in the context of the business model evaluation logics.

	Qualitative	Qualitative & Quantitative	Quantitative
Effectual logic	• Ontologies and frameworks[1] • Evaluation criteria[2] • Learning from analogies through BM patterns[3] • Roadmapping[4]	• Experimentation[5] • Trial and error[6] • Minimum viable product approach[7]	
Causal logic	• SWOT-analysis[8] • PESTEL[9] • Taxonomies and morphological boxes[10] • Expert interviews[11] • Levers for strategic business model innovation[12]	• Analytic hierarchy process[13] • Analytic network process[14] • Balanced scorecards and metrics[15] • Scenario planning[16] • Decision support systems[17]	• Market simulations, predictions and forecasting[18] • Technology forecasting[19] • Customer surveys[20] • Financial spreadsheets[21]

[1] Osterwalder *et al.*(2010); Teece(2010); Thompson and MacMillan (2010); El Sawy and Pereira (2013); Gassmann *et al.* (2014); Morris *et al.*(2005)
[2] Casadesus-Masanell and Ricart (2007); Osterwalder *et al.* (2010)
[3] Gassmann *et al.* (2014); Abdelkafi *et al.* (2013); Amshoff *et al.* (2015); Remane *et al.*(2017); Streuer *et al.* (2016)
[4] Reuver *et al.* (2013)
[5] McGrath (2010); Breuer (2013)
[6] Morris *et al.* (2005); Chesbrough (2010); Sosna *et al.* (2010); Frankenberger *et al.* (2013); Brea-Solís *et al.* (2015)
[7] Sosna *et al.* (2010); Ries (2011); Breuer (2013)
[8] Abdelkafi *et al.* (2013); Martikainen *et al.* (2014)
[9] Yüksel (2012)
[10] Pousttchi and Hufenbach (2011); Kley *et al.*(2011)
[11] Bouwman *et al.* (2009); D'Souza *et al.* (2015)
[12] Bosbach *et al.* (2017)
[13] Sharma and Gutiérrez (2010); Yüksel (2012); Ali (2015)
[14] Yüksel (2012)
[15] Heikkilä *et al.* (2015); Al-debei *et al.* (2015)
[16] Bouwman *et al.* (2008); Bouwman *et al.* (2009); El Sawy and Pereira (2013); Schoemaker *et al.*(2013); Tesch (2016)
[17] Sharma and Gutiérrez (2010); Yüksel (2012); Al-debei *et al.* (2015); Daas *et al.* (2013)
[18] Gordijn and Akkermans (2001); Kauffman and Wang (2008)
[19] Bouwman and van der Duin (2003)
[20] Giessmann and Stanoevska (2012)
[21] Gordijn and Akkermans (2001)

Figure 2. Logic and criteria of tools and methodologies for evaluation (own representation)

4.1 Qualitative Effectual Evaluation

The investigated literature emphasizes the importance of a "common language" on how to describe a business model categorization and design idea as a base for additional considerations throughout a BMI process (Osterwalder *et al.*, 2010). For that matter, frameworks and ontologies serve as valid tools for a qualitative effectual assessment of the schemed business model design, as these help to identify possible shortcomings throughout the continuous elaboration of a BM design. In that sense, frameworks and ontologies may serve as "living documents" which are refined in effect with the continuous learning from, e.g., qualitative evaluation criteria (Casadesus-Masanell and Ricart 2007) throughout the ongoing innovation project. Describing the business model from different stakeholder perspectives in a storytelling way can help assessing critical components (Osterwalder *et al.*, 2010). Fameworks and ontologies primarily serve as a vehicle to continuously discuss and improve the overall business model design (Osterwalder *et al.*, 2010).

Further means of qualitative, effectual evaluation is drawing analogies from past business model innovations (Abdelkafi *et al.*, 2013; Amshoff *et al.*, 2015). According to Remané *et al.'s* (2017) database on business model patterns and corresponding references on case studies, it helps to qualitatively evaluate business models throughout the iterative improvement of the business model design. Thereby, Remane *et al.* (2017) emphasize the use of business model patterns in relation to the iterative effectual business model evaluation paradigms, as proposed by Frankenberger *et al.* (2013) and Gassmann *et al.* (2014). Another proposed tool is Business Model Roadmapping (Reuver *et al.*, 2013), which might be continuously used and adapted to systematically consider a "what-if-perspective" and to ongoing evaluate implementation strategies.

4.2 Combined Qualitative and Quantitative Effectual Evaluation

Learnings from past business model innovations (Sosna *et al.*, 2010; Tesch *et al.*, 2016, 2017) have shown that iterative trial-and-error approaches in BMI endeavours are the most suitable to counteract the high amount of uncertainties and complexity practitioners face. In that sense, effectual means see the future as unpredictable and endeavour to create an effect (Sarasvathy, 2001). Effectual evaluation is used for an iterative exploration (Osterwalder *et al.*, 2010) and experimentation (McGrath 2010). In practice, it means to actively experiment with business models through trial-and-error learning and continuous testing, and supports qualifying central BM elements. (Breuer, 2013). With each iteration of trial-and error, new qualitative and quantitative information is gathered. Based on experimentation with a prototype, e.g., the customer's preferences and willingness-to-pay can be measured quantitatively and qualitatively. Hence, innovation projects adjust its business model step-by-step towards a saturation point, where observations, e.g. with test-customers, measure the business model as tangible (Chesbrough, 2010; Frankenberger *et al.*, 2013; McGrath, 2010; Morris *et al.*, 2005; Sosna *et al.*, 2010; Teece, 2010). A practical operationalization of this can be identified with the "Minimum Viable Product" approach in the publication *The Lean Startup* (Ries, 2011). However, the development of a business model prototype requires an initial decision to release necessary funds (Sosna *et al.*, 2010). The portrayed sources correspond to the definition of Effectuation (Sarasvathy, 2001), and make use of gathered qualitative and quantitative information.

4.3 Qualitative Causal Evaluation

Particularly in the very beginning of a BMI endeavour, it is crucial to understand and capture the environment of the intended business model design. However, before planning a design for a prototype as descried above, one may analytically evaluate such factors via analytical means based on, e.g., desk research. As an example to this logic, using the PESTEL analysis tool, one may qualitatively evaluate political, economic, socio-cultural, technological, environmental and legal shifts in the ecosystem of the business model (Yüksel, 2012, p. 52). SWOT-analysis is proposed to both evaluate a business model sketch's components and the design as a whole (Osterwalder *et al.*, 2010). Thereby, strengths, weaknesses, opportunities and threats to the business model are systematically analysed (Osterwalder *et al.*, 2010). PESTEL and SWOT are proposed to be used prior to the development of a prototype business model (Abdelkafi *et al.*, 2013; Martikainen *et al.*, 2014). Nonetheless, such qualitative causal means of evaluation may be also considered throughout the whole BMI process, as underlying factors are likely to be subject to change.

Sharma and Gutiérrez (2010) propose qualitative metrics as a part of decision-support systems. Thereby, criteria such as collaboration and partnerships, dynamicity, responsiveness to the market trends and scalability may serve as a measure in the context of digital business. Furthermore, Al-debei *et al.* (2015) consider cohesion as alignment of the business model components, or the uniqueness for creating a competitive advantage against competitors and a fitting network-mode, as further considerable qualitative criteria.

Furthermore, the evaluation of sub-aspects may be undergone by conducting qualitative interviews (D'Souza *et al.*, 2015). Such sub-aspects may include technological feasibility, market fit and also customer acceptance. Another element of the qualitative causal logic are morphological boxes (Kley, 2011; Pousttchi and Hufenbach, 2011) or taxonomies (Hanelt *et al.*, 2015; Remané *et al.*, 2017) which facilitate the compression of complex problems.

4.4 Combined Qualitative and Quantitative Causal Evaluation

In general, balance score cards and metrics can be seen as combined qualitative and quantitative means of causal evaluation (Heikkilä et al., 2015; Al-debei et al., 2015). Qualitative causal means of evaluation, such as outlined with PESTEL by Yüksel (2012), may be combined with quantitative tools by weighting the factors equally to their importance. In this particular example, the Analytic Hierarchy Process (AHP)

and the Analytic Network Process (ANP) build upon the findings of qualitative evaluation criteria and enable a quantification to analyse business models and value their elements (Ali, 2015). Combining the quantitatively weighted qualitative criteria with causal graphs, mathematical programming or statistics help to holistically investigate a multitude of aspects of a business model in an analytic manner. This enables multi-criteria decision support systems (Sharma and Gutiérrez, 2010; Yüksel, 2012; Al-debei *et al.*, 2015; Daas *et al.* 2013). Such decision support systems may be used to estimate a potential return on investment of an innovation project and thus indicate the viability of a projected business model (Sharma and Gutiérrez, 2010; D'Souza *et al.*, 2015; Casadesus-Masanell *et al.* 2015).

A very promising, yet scarcely considered causal evaluation methodology is scenario planning. Several frameworks (Osterwalder, 2010; El Sawy and Pereira, 2013) propose scenario planning as an evaluation tool as an integral part. However, these are often missing out explicit guidance on how to use scenario planning in the context of (digital) business model innovation. Scenario planning has its strength in situations of high uncertainty, especially when potential revenues are difficult to forecast. A first attempt to incorporate scenario planning into a BMI process is undergone by Tesch (2016). Within the design process of a business model, such as within workshops or with expert interviews, assumptions influencing the viability of the business model are identified. These assumptions are then mapped on an impact/uncertainty matrix, identifying "critical uncertainties" that mainly drive the future success the projected business model. Having identified correlations between these critical uncertainties, realistic scenarios can be built, allowing for an increased understanding on how the business model design has to be adapted for each case. Considering the innovation of business models with a digital aspect, it is important to focus on the dynamicity of the model (Tesch 2016). The outcomes of scenario planning can be interpreted in qualitative (El Sawy and Pereira, 2013; Osterwalder *et al.*, 2010) or quantitative (Ali, 2015; Gordijn and Akkermans, 2001) ways to evaluate the existing business model design. In sum, considering scenarios has a positive impact on the decision quality (Tesch, 2016).

The outcomes of quantitative and qualitative evaluation tools and methodologies may be collectively interpreted in decision support systems, that individually weight the importance of the different perspectives (Daas *et al.* 2013).

4.5 Quantitative Causal Evaluation

Further means of quantitative evaluation can be identified by surveys, e.g. in order to foster conjoint analysis (Giessmann and Stanoevska, 2012). Existing publications to the topic, however, imply the necessity of a yet pre-evaluated, already existing BM prototype, on which such methodologies may evaluate the business model. Unlike other modes, such purely quantitative causal means of evaluation do not question the existing archetypal logic of the business model, as these rather evaluate sub-elements such as customer segments and willingness-to-pay. Thus, the findings indicate that such quantitative causal tools are rather suitable for an ex-post conformational evaluation of the previous decision to invest in a project with a certain business model. Nonetheless, quantitative causal means of evaluation, as shown by e.g. Zibuschka *et al.* (2016), bear immense potential for the evolutional development of a business model.

Nonetheless, several scientific propositions exist, where quantitative causal means of evaluation are suggested to assist in predicting possible future outcomes. However, these were primarily published in early years of business model research. As an example, Gordijn and Akkermans (2001) create a tool considering profit sheets to evaluate a business model. Thereby, the exchange of value between the business model owner and key stakeholders is considered. With quantitatively simulating several scenarios, the tool seeks to predict if the business model will be viable in the future.

Corresponding to the above findings for quantitative causal evaluation, the results also show that no purely quantitative effectual evaluation methods can be identified in current research, yet. This can be explained by the nature of Sarasavathy's (2001) understanding, where means of quantitative prediction and simulation (Gordijn and Akkermans, 2001; Kauffman and Wang, 2008) appear too complex for an ongoing adaption in effect with the continuous evaluation and refinement of a business model prototype.

5 Towards an Integrative Framework for Digital Business Model Innovation

The above findings have given insight on the use and effect of various tools and methodologies in the field of evaluating business models. In line with that, the digital transformation of industries has progressively influenced research on business model tools and methodologies over time. In terms of the research question outlined, this means that the innovation of the unit of analysis - business models as the intermediator of strategy and processes (Veit *et al.* 2014) – may be systematically supported by evaluation tools and methodologies. Nonetheless, despite the various research contributions in recent years, tools and methods in the context of business model innovation are still under-investigated (Schneider and Spieth, 2013). Existing frameworks of business model innovation tend to describe the projected business model in a too fragmented view. As an advantage, frameworks support the analyzation and explanation of underlying mechanisms. On the contrary, a major issue is that interrelations in between the components are difficult to be captured (Demil and Lecocq, 2010). This is especially true for the highly uncertain and volatile economic context ruled by digitalization (Westerlund *et al.*, 2014). Hence, development processes for digital business models are of a much more iterative nature and less linear as in former innovation paradigms. This generally corresponds to the findings of our research. With regard to the timeline of relevant publications on the evaluation aspect, one can scheme a shift from the proposal of rather causal tools in earlier publications, to a suggest a more effectual trial-and-error evaluation in more recent contributions to BMI.

Particularly, the findings of the literature review point out that future research should lay emphasis on contributing towards an overarching framework for business model innovation, according to the requirements from the emerging novel economic paradigms driven by the digitalization and the Internet of Things (IoT). In general, existing integrative frameworks based on the use of tools and methodologies are often seen as too generic (Brea-Solís *et al*., 2015). This makes it very difficult practitioners to make decisions in an innovation process, particularly in new IS-related themes such as the Internet of Things (Lee and Lee, 2015).

However, first literature on these themes largely emphasize the importance of considering hybrid service and product offerings, the value of data, or an ecosystem perspective as imminent for such an integrative framework (Westerlund *et al.*, 2014; Turber and Smiela, 2014; Fleisch *et al.* 2015). In fact, practitioners' contributions to the field, such as the Business Model Generation from Osterwalder *et al.* (2010), have had a significant impact on research on research on digital business model, as indicated by a large number of scientific citations. Nonetheless, an empirically well-grounded comprehensive approach on the use of tools and methodologies within digital business model innovation is still missing. Particularly, detailed frameworks describing the process of business model considering major decision points may help to shed light into this issue.

A very recent series of studies in the field, building upon evidence from 13 case studies of digital IoT-based business model innovation, revealed the occurrence of two major decision points across the process of all investigated cases in the study (Tesch *et al.*, 2016, 2017). The first point refers to the decision of whether customer-centric business model prototyping and testing should be financed or not. Therefore, the decision-makers consider a corridor of similar, altering business model designs. These lack in further evaluation and are required to be redefined by means of direct customer interaction. The second, subsequent major decision is whether to roll out a converged business model design in at least submarkets or on a global scale. These decision points may be seen as major kill/go decisions within BMI processes; Thus, the findings of Tesch *et al.* (2016, 2017) imply that these decision points may separate generic BMI process in three sequential stages of evaluation surrounding the two major decisions. From the perspective of decision-making in digital business model innovation, the findings of the paper at hand contribute towards an integrated framework of a systematic BMI for digital projects. This is done by shedding light upon the dominant modes of evaluation throughout a BMI process, as outlined in figure 3.

	Analytical stage	Prototyping stage	Scaling stage
Objective of the resulting decision	Selection of a set of concrete business model archetypes (e.g. multi-sided-platform) to be further elaborated through an MVP	Choice of a concrete, sufficiently risk-and-return evaluated business model design for a subsequent market rollout	
Dominant mode of evaluation	Causal, qualitative evaluation logic	Effectual, qualitative evaluation logic	Causal, quantitative evaluation logic
Explanation	Ideation of concepts for a novel business model design. Preparation of customer centric testing with analytic means of evaluation	Prototypal validation and continuous refinement of a pre-defined business model archetype in an MVP state	Implementation of processes, resources and activities of the business model within the firm's organization; Orchestration of partners and stakeholders; Rollout in at least submarkets
The role of evaluation tools and methodologies	Ex-ante, qualitative analytical evaluation of alternative business model designs to elaborate a set of strategic choices	Effectual, trial-and-error based evaluation learning from test-customer interaction to identify the most promising business model design for a market rollout	Evaluation of single components of the concrete business model (e.g. revenue model: pay-per-use vs. subscription) for the consistent setup of business model tactics

Table 1. Logic and criteria of evaluation research articles (own representation)

Above all, both evidence from the case studies investigated by Tesch *et al.* (2016, 2017) and the reviewed literature on BMI tools and methodologies emphasize the importance of an ongoing evaluation. This means that in the beginning of a BMI process, it has been proven to be most beneficial to start with raising hypotheses and assumptions that act as main drivers of the business model's viability. The ongoing use of tools and methodologies accompanying the BMI process reveal further information that contribute to a better understanding of the general viability and potential risks of the BM design. Furthermore, the potential return may be better estimated. The impact of the tools' and methodologies' contribution differs according to the dominant mode of evaluation of the identified stages of the BMI project.

The first general decision is to select a set of concrete, sufficiently evaluated set of business model archetypes. As the funding for a prototype is yet to be clarified, the evaluation is restricted to merely analytical means. "[…] decision-making of management or investors is often driven by rather social skills of the project lead, such as the ability of good storytelling of obtained, rather qualitative information." (Tesch *et al.*, 2016, p. 9). In addition, as the components of business model are interrelated and based on a vast amount of volatile assumptions, the quality of information of quantitative evaluation is limited. Hence, one may argue that that within this stage, supporting tools and methodologies should have a primary focus on causal, qualitative evaluation. This helps elaborate a set of strategic-choices on how to strategically pursue the BMI endeavour (Casadesus-Masanell and Ricart, 2010). In this sense, one may coin the terminology of an initial, *analytical stage* of digital business model innovation before the first decision identified by Tesch *et al.* (2016, 2017). For the second decision point, the information base is gathered by the evaluation of the prototype business model. In particular, the decision point 2 is based on the results on iterative customer interaction, testing and revision of a prototype business model, until the quality of learning from accompanying effectual evaluation reaches a sufficient degree of saturation (Tesch *et al.*, 2016, 2017). In the sense of the strategic choices school of thought on business models (Casadesus-Masanell and Ricart, 2010), the role of evaluation is to identify the most promising business model design for the decision for a market rollout. Even though the quantitative means become more feasible than in the previous phase, as the business model design is more concrete with a prototype, the degree of their information quality is limited, as the viability of a business model has to be evaluated

as a whole; means of quantitatively measuring single components of a business model do not reflect their interrelation. Hence, for the time in between decision point 1 and 2, one may coin the terminology of *prototyping stage*, where the dominant mode of evaluation has an effectual, qualitative logic. In the *scaling stage* after the second decision point, the strategic choice on the business model design is rolled out in at least, the submarkets. At this stage, the owner of the BMI project has committed to a certain archetypal business model design; however, single components may be adapted corresponding to market conditions. As a vehicle, quantitative means are most considerable for their evaluation. For example, conjoint analysis surveying the customer's willingness-to-pay may contribute to an optimal pricing for a revenue model. In this sense, the role of evaluation is to identify relevant tactics (Casadesus-Masanell and Ricart, 2010) to enhance the business model's performance of single components. The dominant mode of evaluation is of a causal, quantitative logic.

6 Avenues for Future Research

The identified tools and methodologies certainly bear their highest potential in the BMI stage of the corresponding dominant logic. This can be confirmed by critically reflecting the literature along with descriptions and case studies for explanation of their use. Thus, the proposed integrative framework opens a new perspective upon the evaluation aspect within procedures to innovate business models. As such, the framework provides the groundwork to derive a multitude of avenues for future research on tools and methodologies:

First, with the framework at hand, future research may critically *review the actual use of the identified tools and methodologies within the proposed stage*. Despite the fact that the viability tools and methodologies within the stage corresponding to the dominant logic are well documented within the scientific literature, it is often based on how these may contribute to an enhanced evaluation of the projected business model design. Given the understanding of the role of tools and methodologies within the regarded stage, future research might deal with the extent to which the tools may actually contribute to the corresponding decision base.

Second, despite the predominant positioning of the framework, *if and how tools and methodologies may also be used in other stages*, can be considered for future research as well. As an example, quantitative causal methods may be predominantly found in the later scaling stage of BMI projects, as in the example outlined by Giessmann and Stanoevska (2012). In this regard, quantitative causal tools serve as an evaluation for potential tactics for the roll-out of the business model. To the best of the authors knowledge, a scientific investigation on if and how such quantitative means for the evaluation of strategic choices, i.e. differing business model archetypes, does not exist yet. For example, transferring the idea of conjoint analysis to an analytical stage may help to elaborate different choice options for the design of the projected business model. This may enhance early managerial decisions and help to lower obstacles for the release of the necessary funds for a subsequent prototyping stage.

Third, drawing analogies from past business model innovations, e.g. operationalized by *business model patterns*, are predominantly taken into consideration in combination with a prototype business model design (Remané *et al.*, 2017). As of yet, existing tools and methodologies (Gassmann *et al.*, 2014; Abdelkafi *et al.*, 2013; Amshoff *et al.*, 2015; Remane *et al.*, 2017) rather emphasize their role on aspects of ideation and stress-testing of sub aspects of the business model (e.g. revenue model patterns: "pay-per-use" vs. "flat rate"). Future research may lie in the field of understanding prerequisites, conditions and success factors for the applications, i.e. guidance as to which pattern is suitable in the BMI project's current situation. Furthermore, drawing analogies from past business model innovations may help critically reflect the business model design when learning from past situations of similar BMI endeavors. Through this, also recurring risks within business models and specific business model types can be identified, analysed and considered in decision-making. However, the reviewed literature does not sufficiently reflect concrete procedures to operationalize this in practice.

Another avenue for future research is to *combine multiple tools and methodologies*. Particularly, a field of research opportunities lies at the intersection of qualitative and quantitative methods in an iterative setting of effectual business model innovation approaches. Purely qualitative tools and methodologies often take a rather subjective perspective on the projected business model and its components. These thus may be biased corresponding to the evaluators experiences. While qualitative means of evaluation have their strengths in assessing critical components of existing business models, they may lack in giving reliable predictions of the intended success of the overall business model. With the study of Ali (2015), it is shown how it may be possible to advance the value of qualitative tools with quantitative means. Transferring such considerations to combine qualitative and quantitative methodologies may be an interesting avenue for further research. A concrete idea may be to consider scenario planning (Tesch, 2016), which is delivering qualitative and quantitative criteria including financial aspects for a what-if perspective (Martikainen *et al.*, 2014). However, the full potential of such scenarios may be only revealed if combined with the elaboration of roadmapping-supported tactics (Reuver *et al.*, 2013). As of yet, a tool allowing such stress-testing considerations needs to be created and validated.

Finally, *risk* and *risk management* was identified as a further fruitful field for research on tooling in digital business model innovation. The presented evaluation criteria and methods can be applied to business model risk management in order to identify and evaluate BM. Strategic foresight may help to reduce reservations by counteracting uncertain assumptions on estimated returns with reliable scenarios. This contributes to make risks calculable and manageable, thus increasing transparency on possible outcomes to decision-makers. Furthermore, future research should explicitly focus on when and how to integrate risk management in the different evaluation stages of BMI.

7 Conclusion

The elaborated integrative framework has given an overview of the various aspects of digital business model innovation, support for decision-making and evaluation. A rigor literature review approach revealed the use and effectiveness of tools and methodologies. This resulted in the categorization into qualitative, quantitative, effectual and causal means of evaluation. However, the findings clearly emphasize that the aspects of evaluation and risk management are still not sufficiently treated. While the research gaps identified in previous literature reviews correspond to the integrative framework for BMI as outlined in Table 1, it helps to structure research avenues for the further development of tools and methodologies. In sum, the paper at hand provides practitioners and scholars with an integrative framework on digital BMI, which helps to further conceptualize on the aspect of evaluation in digital BMI.

The research contribution is subject to several limitations. First, due the novelty of digital business model research, the database search sometimes resulted in very rare results. Furthermore, as the terminology around business models is used in diverse ways and with various definitions, sources without a substantial contribution to the overall research goal were revealed. Second, the very important aspect of evaluating the potential value of data in a future business model lacks significantly in scientific consideration concerning tools and methodologies. Third, the keyword-search only includes results that were rated B or better in the initial step of Webster and Watson's (2002) methodology. This constraint was adjusted in the forward-/backward step to also consider lower-ranked scientific outlets and contributions to a practitioner's audience. Hence, to avoid inobservance of valuable information, a variety of literature which was not rated B or above in the VHB JOURQUAL3 rating was added by the author team. Next, the authors suggested a categorization of tools and methodologies; despite following the rigorousness of Webster and Watson's (2002) approach, the allocation may be biased by the authors' previous knowledge and experiences of business model tooling. Lastly, the authors suggested a dominant evaluation logic for the proposed BMI framework. In this sense, the framework may guide practitioners to deploy viable means of evaluation corresponding to the current state of their BMI project. Nonetheless, tools and methodologies for their concrete problem set still have to be selected thoughtfully and subject to surrounding prerequisites of their innovation project.

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